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THE FOSSIL SALAMANDERS OF THE
FAMILY SIRENIDAE

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No. 7—*The Fossil Salamanders of the Family Sirenidae*

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The Recent salamanders of the family Sirenidae comprise a rather compact group consisting of but two genera and three species. Their distribution is mainly restricted to the southeastern United States, although one species of *Siren* does reach Mexico. It is true that subspecies of the modern forms probably remain to be described, but the family can nonetheless be considered well known taxonomically in so far as Recent forms are concerned. On the other hand, although it has been known for nearly forty years that *Siren lacertina* occurred in the Pleistocene of Florida, their geologic history has remained practically unknown.

Our interest in the fossil sirenids goes back a number of years to the time when the senior author spent half a day with the late Clarence Simpson searching fruitlessly for fossil Sirenidae in the Florida State Geological Survey collection. Material has been slow to accumulate until recently when the junior author undertook a program of collecting the fossil snakes of Florida. Along with the snake material, occasional specimens of Sirenidae were discovered and these form the basis of this report.

So many small isolated deposits of Pleistocene material have been found in some localities, particularly near the village of Haile in western Alachua County, Florida, that it has been necessary for local collectors to refer to them by numbers. Where we have used these numbers to indicate the various deposits, we have given them in Roman numerals.

To facilitate comparisons of measurements of vertebrae of different sizes, in our type descriptions we have, in addition to the actual measurements in millimeters, also calculated each measurement in thousandths of the length of the centrum of that particular vertebra. These figures are given in parentheses following the measurements in millimeters. Unfortunately, the centrum is broken in the type of the Pliocene *Siren* so for it these calculations could not be made.

The two recognized genera of the Sirenidae are *Siren*, with

two Recent species, *lacertina* and *intermedia*, and *Pseudobranchus*, with a single Recent species, *striatus*. The former genus is larger in size and more widespread in distribution. In characters that can be recognized in fossil material, *Siren* differs from *Pseudobranchus* in that the lower margin of the centrum is nearly straight as seen from the side while in *Pseudobranchus* it is quite concave. Furthermore, in *Siren* the zygapophyseal ridge is gently curved or nearly straight and continues forward to meet the transverse process near the base of the prezygapophysis while in *Pseudobranchus* the ridge curves downward to meet and fuse with the transverse process in a shallow V posterior to the base of the prezygapophysis. In *Pseudobranchus* the zygapophyseal ridge has more of a tendency to flare where it fuses with the transverse process than it does in *Siren*.

Genus SIREN

SIREN LACERTINA LINNAEUS

(Figures 1 and 3)

One striking thing about *lacertina* as compared to the other species of *Siren* is its large size; in this respect as well as in morphology the Pleistocene specimens are like *lacertina*. The vertebrae of *intermedia* are smaller but otherwise seem to be indistinguishable from those of *lacertina*.

This species has been known from the Pleistocene since Hay (1917) first recorded it from Stratum No. 3 from Vero, Indian River County, Florida. That it was widespread in Florida during the Pleistocene is shown by recently collected material, and we take this opportunity to summarize the fossil records known to us.

We have seen specimens from the following localities:

Florida, Alachua County

Pit V, near Haile, NE $\frac{1}{4}$, Section 23, R 17 E, T 9 S

Pit IA, near Haile, SW $\frac{1}{4}$, Section 24, R 17 E, T 9 S

Pit VIIA, near Haile, SE $\frac{1}{4}$, Section 24, R 17 E, T 9 S

Pit IIB, near Haile, NW $\frac{1}{4}$, Section 25, R 17 E, T 9 S

Wall Company Pit, approximately 7 mi. W. of Gainesville,
Section 35, R 18 E, T 9 S

Pit IA, Kanapaha, Section 22, R 19 E, T 10 S

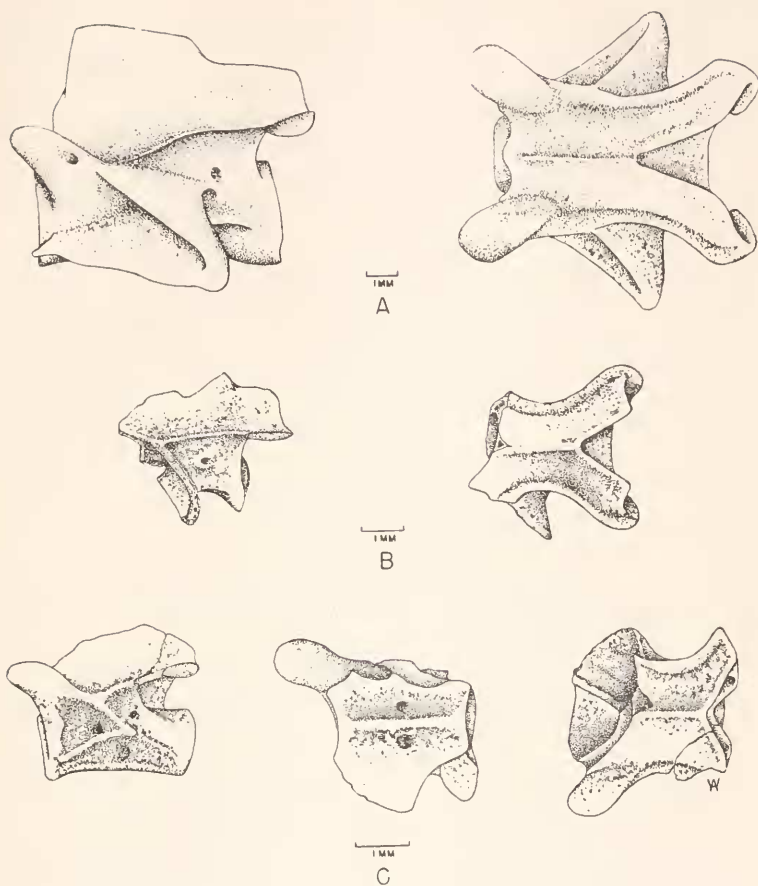


FIGURE 1

A. Lateral and dorsal views of thoracic vertebra of *Siren lacertina*.
B. Lateral and dorsal views of *Siren simpsoni* sp. nov. Type, MCZ No. 2284.
C. Lateral, ventral and dorsal views of *Siren hesterna* sp. nov. Type, MCZ No. 2278.

¹Hornsby Springs, Section 27, R 17 E, T 7 S

Columbia County

¹Ichtucknee Springs, Section 7, R 16 E, T 6 S

Indian River County

¹Vero, Stratum No. 3

Marion County

1 mi. S. Reddick, Section 4, R 21 E, T 13 S

Brevard County

Melbourne

Several vertebrae of a *Siren* quite distinct from both *lacertina* and *intermedia* have been taken from a locality about four miles northeast of the town of Newberry, Alachua Co., Florida. The formation from which these specimens were taken is presumed to be Pliocene. We take pleasure in naming this species for our late friend, Clarence Simpson, who discovered this locality.

SIREN SIMPSONI sp. nov.

(Figures 1 and 3)

Type. MCZ 2284, a thoracic vertebra.

Horizon and locality. Pliocene, Alachua Formation; Pit VI, SW $\frac{1}{4}$, Section 24, R 17 E, T 9 S, a little south of the village of Haile, Alachua Co., Florida.

Referred material. Five thoracic vertebrae and a single second cervical vertebra (MCZ 2285) from the same locality as the type.

Diagnosis. A small *Siren* with the neural arch standing high above the centrum, a nearly straight zygapophyseal ridge as seen from the side and rather wide-flaring aliform processes. It can be distinguished from the Miocene species described below by the straighter zygapophyseal ridge as seen from the side and the smaller angle of the aliform processes. From *lacertina* and *intermedia* it can be distinguished by straighter zygapophyseal ridges as seen from the side and by the wider flare of the aliform processes.

Description of type. Measurements (in mm.): Width of vertebra at narrowest point of zygapophyseal ridges, 2.11. Angle between aliform processes, 62°. Height of anterior end of neural canal, 0.96. Angle of posterior edge of transverse process with axis of centrum, 85°.

¹ These deposits contain subfossil as well as Pleistocene material.

Lower half of centrum broken off, but the upper portion nearly intact. Centrum longer than high. Shape of ventral keel not determinable since it is broken off.

Total length of neural arch greater than length of centrum and its width at the narrowest portion of the zygapophyseal ridges slightly greater than width of centrum. Neural canal broken anteriorly; about rounded posteriorly; provided with a very low median epapophyseal ridge on the floor.

Articulating surfaces of prezygapophyses broken off. Articulating surfaces of postzygapophyses ovate. Zygapophyseal ridges well developed, markedly concave as seen from above. As seen from the side the zygapophyseal ridge is nearly straight and continues forward to near the base of the broken prezygapophysis.

Aliform processes well developed, vertical in position, somewhat rectangular as seen from the side. As seen from above they form an anteriorly pointing V. Floor between aliform processes present, with nearly straight posterior margin.

Neural spine well developed posteriorly; anteriorly it is broken off.

Transverse processes well developed and composed of two platelike portions. The ventral portion a wing-like structure extending from close to the anterior margin of the side of the centrum for about $\frac{3}{4}$ of the length of the centrum. The dorsal portion a flat plate extending from the zygapophyseal ridge somewhat behind the posterior margin of the prezygapophysis downward and backward to the posterior margin of the ventral portion to which it is fused. The posterior margin of the transverse process slants posteriorly. Laterally a foramen is present in the angle between the dorsal and ventral portions of the transverse process and another lies somewhat ventral and posterior to the angle between the dorsal portion of the transverse process and the zygapophyseal ridge.

Variation. The fragmented vertebrae that are referred to this species, in addition to the type, give some clues to variation. The body vertebrae and the cervical vertebra will be discussed separately.

Only two of the body vertebrae have the anterior neural canal complete; in these it is pentagonal in shape. In the one specimen that has adequate zygapophyseal ridges they are not quite so concave as seen from above as they are in the type. The single

specimen in which the aliform processes are discernible has them at about the same angle as does the type. The upper portion of the transverse process meets the zygapophyseal ridge in about the same place as in the type in two specimens and slightly posterior to that point in two others.

The second cervical vertebra mentioned above differs from those of recent species of *Siren* in several respects. The neural arch stands much higher above the centrum and the total height of the vertebra is about a fourth again greater than the length of the centrum whereas in the recent species the height of the vertebra is about equal to the length of the centrum. This difference is reflected in the anterior aspect of the neural canal which in *simpsoni* is higher than wide while in *lacertina* it is wider than high. Furthermore, *simpsoni* has much shorter aliform processes than do the recent species. In this vertebra in *simpsoni* each aliform process is shorter than the neural spine, while in *lacertina* the neural spine is shorter than either of the aliform processes.

All of the specimens of *simpsoni* are broken to a greater or less degree while the specimens of *Pseudobranchius* from the same deposit are more or less intact. This is possibly due simply to the relative size of the two genera since the same condition obtains in snakes from this deposit where again we find the vertebrae of small species largely intact while those of the larger species are apt to be broken.

Locality and associated fauna. The site from which these fossils were taken is about 0.2 miles east of State Highway 235, near the village of Haile, Alachua Co., Florida. The elevation is about 84 feet.

The deposit was exposed during construction of a roadbed for a railroad spur to a commercial limestone quarry. Workmen noticed fossils in the deposit and forwarded them to Clarence Simpson who recognized the association as a non-marine Pliocene one. Mr. Simpson started preliminary excavation but time did not permit him to study the deposit thoroughly before his untimely death. Fortunately, however, he did show Professor A. S. Romer the site and it was at Professor Romer's suggestion that the junior author reopened the deposit for further study.

The upper stratum at this locality has been modified by the construction of the adjoining roadbed. In places where this

stratum has not been disturbed it consists of grayish, unconsolidated sands several feet in thickness. In the spot where the fossiliferous clay was originally exposed, subsequent deposition from the adjoining roadbed has covered the clay with a thin, sandy, grass-covered mantle containing such artifacts as cinders and even rusty nails.

Test borings indicate that the clay bed is approximately thirty feet in diameter and that laterally it grades into a yellowish sandy material that has not been examined for fossils.

The stratigraphy is as follows:

3. A recently modified sandy stratum, containing artifacts of construction 0-1'
2. A faintly bedded, yellowish to brownish sandy clay, weathering to reddish brown on exposure, containing very thin lenses of a plastic grayish clay. Small, polished phosphatic pebbles and boulders composed of cemented grayish phosphatic sands and darker pebbles, as well as smoothly eroded boulders of highly silicified Ocala Limestone are common. Laterally this bed grades into yellow or yellowish brown sands with little clay 1-7'
1. Ocala Limestone.

Remains of a horse, *Hipparion* cf. *minor*, suggest a Pliocene age for the fauna that is found in stratum 2. These clays of stratum 2 apparently represent a fresh water deposit. Several aquatic snakes and a turtle of the genus *Pseudemys*, as well as *S. simpsoni*, occur here. The turtle seems referable to *Pseudemys caelata* Hay, a species definitely associated with a Pliocene fauna at the Mixson locality which lies two miles northeast of Williston, Alachua Co., Florida, and is the type locality of the Alachua Formation. The snakes, still mostly undescribed, and the *Siren* are definitely different from the snakes and *Siren* of the well known Pleistocene localities in Florida and also differ from the snakes and *Siren* of the Lower Miocene of the Thomas Farm.

A single vertebra of a *Siren* from the Miocene was found in a bag of loose matrix taken from the boulder bar in the pit at the Raeford Thomas Farm in Gilchrist County, Florida. This local-

ity has been described in detail by White (1942). This species differs from the one described above and from the two Recent species.

SIREN HESTERNA sp. nov.

(Figure 1,C)

Type. MCZ 2278, a posterior thoracic vertebra.

Horizon and locality. L. Miocene, Arikareean; Raeford Thomas Farm, Gilchrist Co., Florida.

Diagnosis. A small *Siren* with strongly diverging zygapophyses, with a high neural arch, and with a very wide angle (123°) between the aliform processes. The forward sweeping posterior margin of the transverse process and the widely diverging aliform processes serve to distinguish it from *lacertina*, *intermedia* and *simpsoni*.

Description of type. Measurements (in mm.): Length of centrum along midventral line, 2.67. Narrowest width of zygapophyseal ridges, 2.3 (.861). Height of vertebra from lower margin of centrum to a line drawn between facets of postzygapophyses, 2.06 (.772). Angle between aliform processes, 123° . Angle of posterior edge of transverse process with axis of centrum, 120° .

Centrum longer than high; posterior glenoid cavity oval to round. Centrum provided with a median ventral keel, on either side of which is found a single, relatively large, subcentral foramen. Margin of ventral keel nearly straight.

Total length of neural arch greater than length of centrum and its width at the narrowest portion of the zygapophyseal ridges slightly greater than width of centrum. Neural canal about rounded posteriorly; without a well developed median epapophyseal ridge on the floor.

Articulating surfaces of prezygapophyses oval in shape, longer than wide, directed more anteriorly than laterally. Their greatest length 1.8 (.674). Articulating surfaces of postzygapophyses broken. Zygapophyseal ridges well developed, markedly concave as seen from above. As seen from the side the zygapophyseal ridge is nearly straight but slants downward anteriorly, meeting the transverse process near the base of the prezygapophysis.

Aliform processes well developed, vertical in position, somewhat rectangular as seen from the side. As seen from above they form an anteriorly pointing V. Floor between aliform processes present but with posterior margin eroded.

Neural spine well developed but its margin eroded so that its form is indeterminable.

Transverse processes well developed and composed of two platelike portions, of which the ventral seems to be larger than the dorsal. The ventral portion is a winglike structure extending from the anterior margin of the side of the centrum for about $\frac{3}{4}$ of the length of the centrum. The dorsal portion is a flat plate extending from the posterior margin of the prezygapophysis downward and backward to the posterior margin of the ventral portion to which it is fused. Transverse process as well as can be determined slants upward from the horizontal. Laterally a foramen is present in the angle between the dorsal and ventral portions of the transverse process and another lies between the dorsal portion of the transverse process and the zygapophyseal ridge.

Genus PSEUDOBRANCHUS

A species of *Pseudobranchus* with large and robust vertebrae has been collected at two Pleistocene localities in Alachua County.

PSEUDOBRANCHUS ROBUSTUS sp. nov.

(Figure 2,B)

Type. MCZ 2279, a middle thoracic vertebra.

Horizon and locality. Pleistocene; Pit VIIA, SE $\frac{1}{4}$, Section 24, R 17 E, T 9 S, a little south of the village of Haile, Alachua Co., Florida.

Referred material. Five vertebrae (MCZ 2280) from the same locality as the type and a single vertebra (MCZ 2281) from the Pleistocene at Kanapaha, Pit 1A, Section 22, R 19 E, T 10 S, in Alachua County, Florida.

Diagnosis. A *Pseudobranchus* with large, massive articulating facets on the zygapophyses and with the margins of the zyga-

pophyseal ridges pronouncedly concave as seen from above. It differs from the modern species in the wider angle between the aliform processes and in the more concave sides of the zygapophyseal ridges as seen from above. From the Pliocene species described below it differs in the stronger concavity of the zygapophyseal ridges and in the more widely flaring, relatively shorter aliform processes.

Description of type. Measurements (in mm.): length of centrum along midventral line, 2.36. Width of vertebra at narrowest point of zygapophyseal ridges, 1.11 (.470). Height of vertebra from lower margin of centrum to a line drawn between facets of postzygapophyses, 1.31 (.555). Distance between outer edges of prezygapophyses, 2.21 (.936). Distance from tips of prezygapophyses to tips of postzygapophyses, 3.08 (1.305). Angle between aliform processes, 81° . Width of anterior glenoid cavity, 1.20 (.508); height of anterior glenoid cavity, 0.89 (.377). Width of neural canal, 0.86 (.364); height of neural canal, 0.53 (.225). Angle of posterior edge of transverse process with axis of centrum, 90° .

Centrum longer than high; glenoid cavity oval, wider than high. Centrum provided with an elevated, ridge-like, median ventral keel, on either side of which is found a relatively large, subcentral foramen. Margin of ventral keel pronouncedly concave.

Total length of neural arch greater than length of centrum and its width at the narrowest portion of the zygapophyseal ridges slightly greater than width of centrum. Neural canal an inverted crescent anteriorly; about rounded posteriorly; provided with a very low median epapophyseal ridge on the floor.

Articulating surfaces of prezygapophyses oval in shape, longer than wide, directed more anteriorly than laterally. Articulating surfaces of postzygapophyses ovate. Zygapophyseal ridges well developed, markedly concave as seen from above. As seen from the side the zygapophyseal ridge forms a very shallow V with the apex at the point where the dorsal portion of the transverse process meets the zygapophyseal ridge.

Aliform processes well developed, vertical in position, somewhat rectangular as seen from the side but the left one somewhat eroded. As seen from above they form an anteriorly pointing V. Floor between aliform processes present, with nearly straight

posterior margin.

Neural spine well developed, but dorsal margin broken.

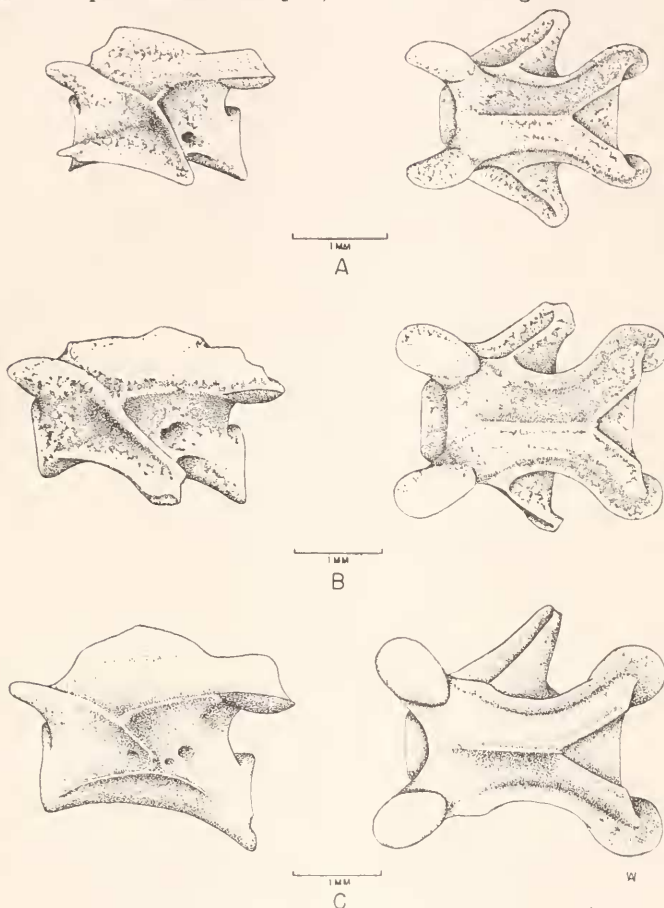


FIGURE 2

A, Lateral and dorsal views of thoracic vertebra of *Pseudobranchius axanthus*. B, Lateral and dorsal views of *Pseudobranchius robustus* sp. nov. Type MCZ No. 2279. C, Lateral and dorsal views of *Pseudobranchius vetustus* sp. nov. Type, MCZ No. 2282.

Transverse processes well developed and composed of two platelike portions, of which the ventral is larger than the dorsal.

The ventral portion a wing-like structure extending from close to the anterior margin of the side of the centrum for about 4/5 of the length of the centrum. The dorsal portion a flat plate extending from the zygapophyseal ridge somewhat behind the posterior margin of the prezygapophysis ventrally and posteriorly to the posterior margin of the ventral portion to which it is fused. The posterior margin of the transverse process is approximately perpendicular to the axis of the centrum. Laterally a foramen is present in the angle between the dorsal and ventral portions of the transverse process and another lies somewhat ventral and posterior to the angle between the dorsal portion of the transverse process and the zygapophyseal ridge.

Variation. The six vertebrae referred to this new species in addition to the type are remarkably constant in specific characters, and most of the variation seems due to erosion or to fragmentation. They all have wide-flaring aliform processes and they all have the zygapophyseal ridges pronouncedly concave as seen from above. In them the same massive structure so apparent in the type is characteristic. Without exception the dorsal portion of the transverse process fuses with the zygapophyseal ridge posterior to the base of the prezygapophysis and the angle of the zygapophyseal ridge where it meets the dorsal portion of the transverse process is about the same as it is in the type and definitely more obtuse than it is in *striatus*. One of the vertebrae must have been from the very anterior portion of the thorax since a double articulation for a two-headed rib can be seen on the tip of the transverse process. The most pronounced variation discernible in these six vertebrae is in the margin of the median subventral keel. In four of them it is quite concave, as in the type of *P. robustus* and in modern *P. striatus*, but in one of them the curve is more reduced. In the sixth specimen the centrum is fractured. The massiveness of the vertebrae, the large size of the articulating facets, and the pronounced concavity of the zygapophyseal ridges are as characteristic of these six vertebrae as of the type.

Locality and associated fauna. The site from which the type was taken is on the north end of a large limestone pit about 0.5 miles east of State Highway 235, near the village of Haile, Alachua County, Florida. The elevation is about 84 feet.

The stratigraphy is as follows:

4. A reddish-brown sandy clay containing few fossils 0-3'±
3. A complex stratum composed of many intergrading lenses of whitish sands, brownish sands, numerous bits of eroded Ocala limestone, grayish sandy clays, etc. 3-7'±
2. A bedded, bluish to bluish gray clay forming the lowest layer of the deposit 7-15'±
1. Ocala Limestone

The presence of *Equus*, *Dasyus bellus*, *Holmesina* and *Testudo sellardsi* indicate the Pleistocene age of the fauna. The general structure of the formation suggests that it was laid down in a sink hole pond and the presence of *Pseudobranchus*, *Siren lacertina*, *Alligator*, *Pseudemys* and *Natrix* may be considered indicative of a pond fauna. The *Pseudobranchus* was collected from Stratum 3.

An undescribed species of *Pseudobranchus* was found in the same Pliocene deposit in which *Siren simpsoni* was found. For this new *Pseudobranchus* we propose the name

PSEUDOBANCHUS VETUSTUS sp. nov.

(Figure 2,C)

Type. MCZ 2282, a thoracic vertebra.

Horizon and locality. Pliocene, Alachua Formation; Pit VI, SW ¼, Section 24, R 17 E, T 9 S, a little south of the village of Haile, Alachua Co., Florida.

Referred material. Six vertebrae (MCZ 2283) from the same locality as the type.

Diagnosis. A *Pseudobranchus* in which the neural arch stands high on the centrum. It differs from *robustus* in the less concave zygapophyseal ridges as seen from above and in the reduced angle between the aliform processes. From the Recent species it differs in having a higher neural arch.

Description of type. Measurements (in mm.): Length of centrum along midventral line, 2.36. Width of vertebra at narrowest point of zygapophyseal ridges 1.46 (.619). Height of vertebra from lower margin of centrum to a line drawn between facets of postzygapophyses, 1.53 (.648). Distance between outer edges of prezygapophyses, 2.10 (.890). Distance from tips of prezyga-

pophyses to tips of postzygapophyses, 3.26 (1.381). Angle between aliform processes, 57° . Width of anterior glenoid cavity, 0.89 (.377); height of anterior glenoid cavity, 0.94 (.398). Width of neural canal, 1.14 (.483); height of neural canal 0.69 (.292). Angle of posterior edge of transverse process with axis of centrum, 78° .

Centrum longer than high; glenoid cavity round. Centrum provided with an elevated, ridge-like, median ventral keel, on either side of which is found a relatively large, subcentral foramen. Margin of ventral keel pronouncedly concave.

Total length of neural arch greater than length of centrum and its width at the narrowest portion of the zygapophyseal ridges slightly greater than width of centrum. Neural canal pentagonal, wider than high; about rounded posteriorly; provided with a very low median epapophyseal ridge on the floor.

Articulating surfaces of prezygapophyses oval in shape, longer than wide, directed more anteriorly than laterally. Articulating surfaces of postzygapophyses ovate. Zygapophyseal ridges well developed, markedly concave as seen from above. As seen from the side the zygapophyseal ridge forms a very shallow V with the apex at the point where the dorsal portion of the transverse process meets the zygapophyseal ridge.

Aliform processes well developed, vertical in position, somewhat rectangular as seen from the side. As seen from above they form an anteriorly pointing V. Floor between aliform processes present, with concave posterior margin.

Neural spine well developed.

Transverse processes well developed and composed of two platelike portions of which the ventral is larger than the dorsal. The ventral portion a wing-like structure extending from the anterior margin of the side of the centrum for about $\frac{2}{3}$ of the length of the centrum. The dorsal portion a flat plate extending from a point on the zygapophyseal ridge somewhat posterior to the posterior margin of the prezygapophysis ventrally and posteriorly to the posterior margin of the ventral portion to which it is fused. The posterior margin of the transverse process is not quite perpendicular to the axis of the centrum. Laterally a foramen is present in the angle between the dorsal and ventral portions of the transverse process and another lies somewhat posterior and ventral to the angle between the dorsal portion of

the transverse process and the zygapophyseal ridge.

Variation. The six vertebrae referred to this new species in addition to the type seem constant in specific characters. The flare of the aliform processes is similar to that in the type and the zygapophyseal ridges show about the same degree of concavity as seen from above, except in two which are apparently from the anterior portion of the body. In these two the sides are more nearly straight. The anterior articulating facets are similar to those of the type; in three of the five which have good posterior articulating facets, they are slightly narrower and longer than they are in the type. The point of fusion between the dorsal portion of the transverse process and the zygapophyseal ridge is similar to the type in five out of six. In the other, a more anterior vertebra, the transverse process joins the zygapophyseal ridge near the base of the prezygapophysis. The degree of concavity of the median subventral keel is similar to the type in three specimens, but in two it is more nearly straight; in one the margin is broken. Two out of the six have the aliform processes not so high as in the type and other four specimens. In the one specimen that has a complete neural spine, the spine is highest anteriorly and the anterior margin is practically vertical.

EVOLUTIONARY TRENDS

Several general trends can be noted in the evolutionary history of the Sirenidae. In the genus *Siren* there is a pronounced tendency for the angle between the aliform processes to be reduced with time. *S. hesterna* of the Miocene has the widest angle and the two Recent species have the smallest. Correlated with this there is an elongation of the aliform process in relation to the length of the neural spine. It seems that the change is simply a transposition forward of the apex of the angle where the aliform processes meet, resulting in a reduction of the angle between them, a lengthening of the aliform processes and a reduction in the length of the neural spine all at the same time.

Another trend seems to be the reduction in the height of the neural arch, with the arch of *hesterna* standing highest above the centrum and that of the Recent species the lowest.

The latter tendency occurred in the genus *Pseudobranchius* from the Pliocene to the present day species although it is not

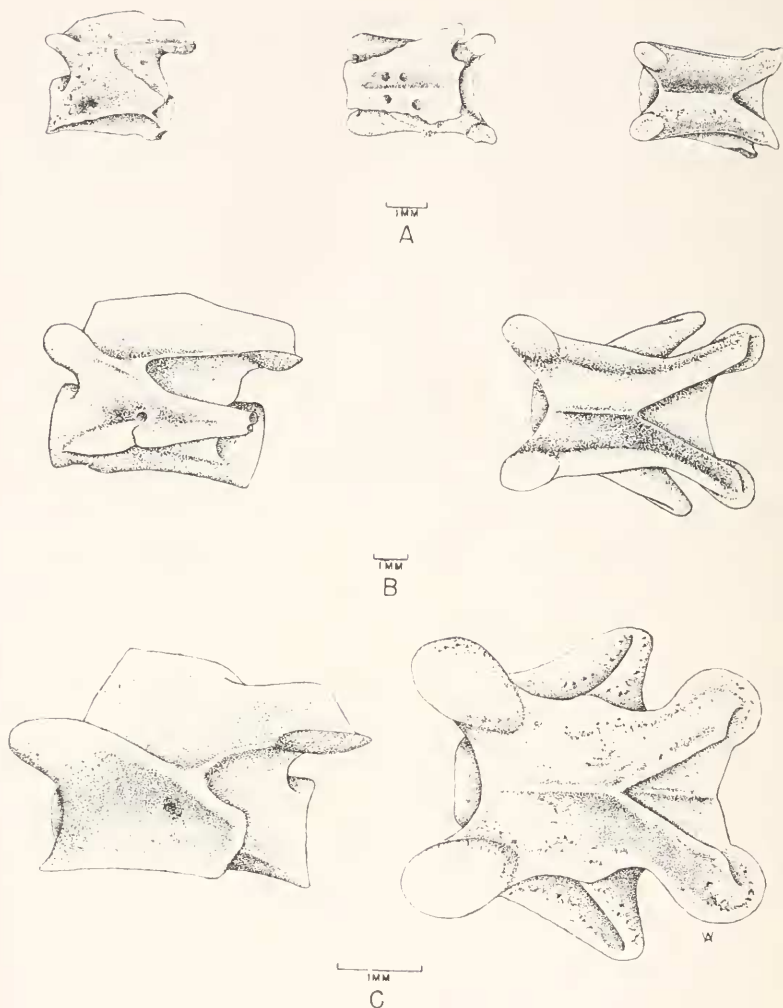


FIGURE 3

A, Lateral, ventral and dorsal views of second cervical vertebra of *Siren simpsoni*. B, Lateral and dorsal views of second cervical vertebra of *Siren lacertina*. C, Lateral and dorsal views of thoracic vertebra of *Pseudobranchius s. striatus*.

so pronounced in this genus as in *Siren*.

The presence of both genera in the same deposit in the Pliocene gives assurance that the two genera must have become separate at some earlier date. This need not be projected backward very far however, for *P. vetustus* of the Pliocene is much more *Siren*-like than any of the more Recent forms of the genus and this may indicate that at that time they had not been too long separated.

The most obvious single evolutionary step is the large size attained by *lacertina* in the Pleistocene. All the other species are small, as small as or smaller than Recent *intermedia* from Florida. The earliest known *Siren* was thus a small, *intermedia*-like species and the line of small forms continues from the Miocene to the present, with the large *lacertina* probably derived from this line during the early Pleistocene. Thus the Sirenidae, like so many other groups, has a Pleistocene representative that exhibited a saltatorial increase in size.

In the genus *Pseudobranchius*, the well known form *axanthus* and the poorly known *striatus*, which has not even been collected in recent decades, have been considered as races of a single species, primarily on geographic grounds. However, there is enough divergence in the vertebrae of these two forms to deserve special comment. *P. s. striatus* has a heavier, more robust vertebra than does *axanthus* and in addition it has a low, median ridge on the floor between the aliform processes. While there may be no reason that differences of this sort could not occur between two subspecies of a single species, they do suggest that it might be worth while to reinvestigate the status of these two forms when material from the appropriate localities becomes available. The vertebrae of *P. s. spheniscus* we have examined, while exhibiting minor differences, seem to be essentially similar to those of *axanthus* rather than to those of *striatus*.

Table 1 gives a summary of the distribution of the Sirenidae in time as we now know it.

Table 1

Recent	<i>Siren lacertina</i>
	<i>Siren intermedia</i> (2 described subspecies, <i>intermedia</i> and <i>nettingi</i>)
	<i>Pseudobranchius striatus</i> (5 described subspecies, <i>striatus</i> , <i>axanthus</i> , <i>spheniscus</i> , <i>lustricolus</i> , and <i>belli</i>)
Pleistocene	<i>Siren lacertina</i>
	<i>Pseudobranchius robustus</i>
Pliocene	<i>Siren simpsoni</i>
	<i>Pseudobranchius vetustus</i>
Miocene	<i>Siren hesterna</i>

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